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Problem-Based Learning: Cervical Adenocarcinoma Three-Session Case for First-Year Medical Students—Patient Minnie Pauls

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Abstract

Introduction: Cervical adenocarcinoma represents a critical health problem in many underserved regions of the world and parts of the U.S. This module provides learning opportunities in the areas of female anatomy, physiology, histology, and pathology. This includes diagnosis by ultrasound and CT/PET scan, detailed staging and treatment of the cancer by various criteria, and future prevention by vaccination and screening. **Methods:** Authors include a fourth-year medical student and a seasoned PBL facilitator with a basic science interest in cancer. In this problem-based learning module (PBL), a group of first-year medical students review the material that is released online for each of three weekly 90-minute sessions. Key learning issues are identified, researched out-of-class, and discussed at the beginning of the subsequent session. A differential diagnosis is weighed and the module culminates with a concept map drawn by students to integrate all relevant aspects and mechanisms of the case. **Results:** The module was implemented twice with a small group of seven students. Students learned to correlate relevant biochemical mechanisms, histological, and anatomical features with the clinical signs and symptoms, to diagnose and suggest treatment options. The module was well-liked, and revised for publication by rebalancing the material based on specific student feedback. **Discussion:** The PBL small-group format provides a unique opportunity over both semesters for first-year medical students to study clinical cases in a student-directed fashion and develop professional skills at various levels. Potential pitfalls lie in the online format, as this requires clear rules on computer usage and data sharing.

Keywords

Pap Smear, Bimanual Examination, Pelvic Anatomy, Papanicolaou Test, Cervical Epithelial Histology, Cervical Carcinoma Staging, HPV Vaccines, Papillomavirus Vaccines, Transvaginal Ultrasound, CT/PET Scan, Positron Emission Tomography Computed Tomography, Colposcopy

Appendices

- A. PBL Pauls Session 1.docx
- B. PBL Pauls Session 2.docx
- C. PBL Pauls Session 3.docx
- D. PBL Pauls Case Overview .docx
- E. PBL Pauls Complete Facilitator.docx
- F. PBL Pauls Sample Concept Map.pptx
- G. PBL Pauls Case Group Evaluations.docx
- H. Grading Rubric.pdf

All appendices are peer reviewed as integral parts of the Original Publication.

Educational Objectives

By the end of this problem-based learning case, learners will have acquired skills to:

1. Identify learning issues and use evidence-based medicine skills to access appropriate resources, answer research questions, and work as a team.
2. Utilize the patient information and clinical findings to formulate and support the specific differential diagnosis for cervical cancer.
3. Describe relevant biochemical mechanisms, as well as histological and anatomical features and apply these to the clinical signs and symptoms of this patient.
4. Justify the final diagnosis based on knowledge of the clinical symptoms and staging of cervical cancer, and prioritize both evaluation and treatment.
5. Analyze the impact of social and environmental determinants of health and socioeconomic factors on cultural competency, including potential for bias and discrimination in the care of this patient, and considering the availability of HPV vaccines.

Introduction

Problem-based learning (PBL) is a pedagogical approach and curriculum format used in higher education with several defining characteristics.^{1,2} Rather than having a teacher provide facts and then testing the students' ability to recall these facts via memorization, PBL attempts to motivate students to apply knowledge to new topics. Students are faced with the definition of contextualized problems and are asked to identify, discuss, and implement meaningful solutions. They work as student-directed, active investigators and problem-solvers in small collaborative groups. Student learning is driven, in part, by their work on challenging, open-ended problems that lack a single specific answer. Teachers take on the role learning facilitators, guiding the process and promoting an environment of inquiry and teamwork.

PBL's relatively recent influence arose in the late 1960s at the medical school at McMaster University before spreading to other universities and topics.^{3,4} Over the years a considerable number of resources have become available to help facilitators design and evaluate PBL cases. Examples of such resources include the "PBL Blueprinting Toolbox," "Eight Vignettes for Problem-Based Learning Faculty Development," "Problem-Based Learning Faculty: IQ Team Faculty Training Manual," and "How to Create and Moderate a Great Problem-Based Learning Discussion (PBLD)."⁵⁻⁹ The PBL format can help teach critical thinking, the reading and processing of scientific literature, and the development of doctor-patient communication skills.^{10,11}

A considerable number of PBL cases are available on MedEdPORTAL and elsewhere for first-year medical students with a focus on various diseases and conditions such as methemoglobinemia, thyroid disease, pneumonia, substance abuse, thalassemia, child abuse, hereditary hemochromatosis, and myocardial infarct, and metabolic diseases.¹²⁻²⁰ In addition, the West Virginia University School of Medicine, has an active PBL program involving several dozen cases that are well integrated into the first-year medical curriculum and has resulted in a number of additional recent PBL-specific publications, some of which include patient simulations.²¹⁻²³ However, the recent institutional PBL curriculum was lacking in formal cancer cases with the exception of one on lung cancer created by the senior author.²³ Thus, an obvious gap existed for the authors to fill.

Based on consultations with a number of colleagues, a cervical cancer case was chosen to provide for a complex and intriguing PBL session. This cervical cancer case represents a critical health problem in many underserved regions of the world as well as in parts of the U.S. Key learning opportunities are provided in the areas of female anatomy, physiology, histology, and pathology. Diagnosis by ultrasound and CT/PET scan is presented as is detailed staging and treatment of the cancer by various criteria. Prevention of this disease by vaccination and screening are additional highlights of the case.

Methods

Student copies of the PBL case sessions 1-3 (Appendices A-C, respectively), as well as the case overview (Appendix D) contain the case information and are made electronically accessible to students on a time-released schedule. The PBL case consists of three sessions and runs over 3 weeks. One session is discussed during each weekly 60- to 90-minute class meeting in a stepwise fashion covering the designated parts of each session sequentially. Each session is released online to the students at the beginning of the respective class meeting without any advance preparation time. After the last session has been completed, the case overview (Appendix D) is released online. It summarizes the information that students were expected to develop during the three sessions.

The facilitator copy of the PBL case (Appendix E) contains the complete disclosure information for all three successive sessions with the same section layout as in the student copy. It also contains the case overview, supplemental information, and questions embedded in the text to aid the facilitator in group facilitation. It begins with a case overview that gives typical background information on the problem, the basic science underlying its signs and symptoms, and treatment options. Additionally, as the case progresses, shaded, bordered "Notes for Facilitator" boxes are embedded at strategic points to explain diagnostic tests, treatments, additional symptoms, and other aspects of the case. The facilitator-specific

information is provided continuously online, and is designed to allow facilitators to ask meaningful questions during the sessions and evaluate the completeness and accuracy of the material that the students present based on their learning issue research.

No other materials are needed for the case. The included case overview and the information boxes in the facilitator copy provide sufficient background information to a facilitator with basic scientific training. It should be noted that to the students, the facilitators are routinely basic science faculty and they are not intended to be a source of clinical medical information. Instead, students obtain the required information during their case discussion, from their collective knowledge base, and from researching specific learning issues that they define at the end of the first and second session. The result of their research as homework between sessions is then discussed at the beginning of the following session. A final concept map represents the culmination of the third session, when the case is concluded. The main objective of this map is to allow students collectively to connect and integrate all aspects of a case visually on a white board. Only after this is concluded do students obtain the case overview for comparison with their own analysis to help identify issues they may have missed.

The authors created a sample concept map (Appendix F) to provide an example of how the various symptoms, findings, underlying mechanisms, and broader aspects of the patient can be connected. This map serves as a reference to other facilitators for their PBL groups, and is useful when comparing student-created concept maps.

Evaluation

Two PBL group case evaluations from the cases implemented in fall 2015 and spring 2016 (Appendix G) have been included on the standard evaluation forms used in the PBL program at the author's institution. This form may be adapted to when administering this PBL. Historically, these provided positive feedback and constructive critique from each group of seven students after concluding the case. In response to these and many more verbal comments in class, the current submission has been revised. The critique provides the reader with direct insight into some aspects of how the original version of the case was perceived by the PBL groups. It is expected that the case will continue to be improved and updated as new information becomes available.

The grading rubric form (Appendix H) defines four areas of assessment and specific performance expectations. This form attempts to elucidate in more detail what skills the students are expected to demonstrate in each area and provide specific performance examples for each grade. At the author's institution, these forms are typically used during the midterm evaluation and the final evaluation at the end of the course.

As part of the student evaluation, each student must meet with the facilitator at the midterm for a 20-minute discussion about any aspect of the course and how to optimally develop the group. The meeting begins with a self-evaluation by the student in the following four categories: demonstrates use of a knowledge base, demonstrates knowledge acquisition skills, demonstrates reasoning and problem solving skills, and demonstrates group communication and teamwork skills. Grades of unsatisfactory, satisfactory, or excellent are assigned in each category and an average of satisfactory is required to pass the course. The facilitator then submits a narrative for each student describing the observed activities and performance, and assigns a final pass/fail grade. This also includes the context of how issues discussed during the midterm meeting have been addressed. This narrative is organized into the four categories shown above with individual grades for midterm evaluations. In addition, the facilitator completes an additional professional evaluation form for each PBL student.

Module Sequence

Session 1: The material for each session is released online just before the beginning of the session. The objective is to ensure that students explore the new case material as a team from the beginning without individual prior preparation time. It should be noted that the use of electronic files is important in this PBL. However, students using laptops and other electronic devices may provide distractions, so computer use

needs to be discussed and controlled early on so that students do not spoil their own experience by simply searching for the correct diagnosis.

Students typically start the new case with one student reading out loud the first two or three paragraphs of the material until there is a natural gap for a pause to discuss what has been learned. This provides an opportunity to reflect on the new information obtained, to share existing knowledge, to look up any questions related to terminology, and to begin to define larger learning issues that will be researched independently by every student as homework for the next session. This continues in a stepwise fashion with other students volunteering to read out loud the next few paragraphs, and pausing again for discussion and reflection. The key role of the facilitator is to aid the students in this process by ensuring that this stepwise process of analysis is followed, and asking guiding questions where necessary. The exact input of the facilitator will greatly vary between groups based on group dynamics and how self-motivated the groups are to analyze the case material. It is typically very helpful if students record relevant pieces of information on a whiteboard. Information such as symptoms, diagnostics, and an emerging differential diagnosis may be recorded on the white board. Of note regarding differential diagnosis, student-created differential diagnosis typically focuses on cancer, but may also include menopause, uterine fibrosis/mass, or sexually transmitted disease. Hypothyroidism may also be discussed, but usually ruled out early. Psychosocial issues in the case are usually recognized, and students typically recommend expansion of that aspect in the case.

The recording of information on the white board allows everyone in the room to reflect on the same key information to proceed in case analysis. During this process students will identify major topics where more information is needed, and arrive at a list of a handful learning issues at the end of sessions 1 that will be researched by each student independently as homework for presentation at the next session.

During this and subsequent sessions, one student typically records the information listed on the whiteboard in a text document, which is emailed after each class to each participant and the facilitator. This document grows further in session 2 and provides students with an outline of key case issues that will become a resource to build the concept map at the end of session 3. The role of the facilitator is to help students find a format to analyze the case (such as what has been explained above) that is supported by the dynamics of the individual group. This will differ between groups based on its individual members. It is important to remember that PBL is a student-driven course format, and the facilitator is expected to help the group achieve their own best potential. This involves a lot of encouragement, and sometimes striking a balance between trying to support a minimum standard and over-guiding the group. Under this guidance, a weaker group may develop over the term to become both productive and excited about their interactions and their learning outcomes. This will lead to significantly decreased facilitator input over the term.

Session 2: The second session frequently starts with a brief student reflection on session 1. This naturally includes an element of peer review, which is informal. The first agenda item is the presentation and discussion of the student findings on the learning issues that the group had defined during the previous session. Students are encouraged to hone their presentation skills in this process and use a variety of media to illustrate their points. Students are encouraged to volunteer in these activities, and there is an expectation that everyone participates and shares the various responsibilities in class. Discussion of the learning issues may take up to 30 minutes with the remaining time available to read and discuss the new case material in the same format as in the first session, and record all notable issues on the board. The second session concludes by defining new learning issues to be researched individually by students in preparation for the third session.

Session 3: The third session starts with the presentation of the new findings on the learning issues resulting from the second session for approximately 30 minutes, followed by reading and discussing the material released for the third session. This is brief and typically limited to less than one page since there will be no further opportunity for students to research and discuss new information at a future session. The review of the new material will then lead to a final reflection on the case, which is also aided by the written

information collected during sessions 1 and 2. This is followed by the development of a comprehensive multicolor concept map on the white board. This concept-map exercise represents the ultimate challenge to each group, as students need to process and integrate all of the available information into this map that connects the various aspects of the case. Groups typically categorize the various types of information by color (symptoms, diagnostics, mechanisms, etc.), with the ultimate goal being to design a map that allows for a considerable number of connections between the various items in multiple categories.

This map represents a key challenge to most groups. The first challenge will be for students to agree on a joint strategy for the design of the map given numerous available options. Another challenge lies in having the whole group participate in feeding the recorder of the map information for the board. Most groups settle for one single recorder but some can be motivated to participate all on the board (if space permits) which typically results in a maximum learning experience for all involved. This challenges everyone to keep the complete picture in sight. The concept map routinely results in a lively discussion to reach an agreement of what content is spelled out and how this information is connected to other items on the board. As a result most groups acknowledge that they learn about the relationship between distinct aspects of the case and group during this exercise. Each case concludes when students complete the case evaluation form (Appendix G) and photograph the final concept map. The evaluation form, the photo of the concept map, and the learning issues resulting from the two sessions (optionally including additional information recorded by the students) are collected from each group and case and submitted to the course leadership. Concept maps between groups probably represent one of the greatest variables in the course. While each facilitator can try to help the group in the process, group dynamics will remain a defining variable.

Results

This case has been implemented twice at the West Virginia University School of Medicine over two terms (fall 2015, spring 2016) with seven students experiencing the case each term. For this case, students were experiencing their first term in the PBL curriculum in the fall and their second term the following spring. As a result, the perspectives of the two exposed groups of students differed based on their level of familiarity with the PBL program. As facilitator, the senior author received direct feedback about all aspects of the case from the students. The case was well received and the critiques were favorable overall. Several comments from both groups led to a rebalancing of the material. Since students have formal opportunities to research learning issues only after sessions 1 and 2, the new material introduced in session 3 is always kept to a minimum. The authors plan to update the case based on future feedback and new developments in the future.

Extensive verbal and some written feedback on the case were received from students over both terms. Students liked the extensive patient history provided, some of the medical jargon used, the multiple symptoms and systems involved, the provided images (including radiology and accompanying explanations), the repeated presentation of the patient's own words, and use of the physician's Plan-Do-Check-Act approach. In addition, the topic of cancer staging and histology, the coverage of the female reproductive cycle and health, and the impact of HPV were also looked upon favorably in the context of the now available vaccines. Other positive aspects of the PBL included the detailed information regarding the patient's own experience of the symptoms, her medical knowledge, and her access to health care (insurance).

Specific written student feedback was recorded and included in the Sample PBL Group Case Evaluation Forms (Appendix G). Each form represented the comments of one whole group of seven students. Significant overlap between both groups was noted. Overall, this feedback demonstrated substantial progress towards many aspects of the stated learning objectives. Specifically, student teams were able to use evidence-based skills to access resources, answer research questions, and define learning issues. A differential diagnosis was formulated based on the integration of available information. Students were able to correlate relevant biochemical mechanisms, histological, and anatomical features with the clinical signs and symptoms of the patient, and arrive at the correct diagnosis and treatment options. Students were

able to recognize the impact of social and environmental determinants of health and socioeconomic factors on the case. This included possible future prevention by vaccination. Finally, participants developed student-directed learning, communication, and teamwork skills during the progress of the case.

The PBL small-group format provided a unique opportunity over both semesters for first-year medical students to study clinical cases in a student-directed fashion, and develop professional skills at various levels. The format also provided a unique opportunity for a small group of students and the facilitator to get to know each other well. This frequently led to strong and positive group dynamics and interactions that would benefit the students long after the course has ended. It is the student comments in particular that evolve PBL cases and the course format in the classroom. The positive results of the two implementations of the case and the resulting minor changes made the resource a promising tool for first-year medical students in many environments.

PBL is offered over both terms of the first-year medical curriculum, and groups are mixed between terms so that no student or facilitator would meet a second time. It should be noted that the experience students have with PBL in their respective group in the first term sets their expectations for the second term. If this experience was particularly relaxed with very limited expectations, students will likely be harder to motivate to perform in a new group setting in the second term.

As a general concept it appears best to avoid asking any specific student for comments but rather always look for volunteers. This concept has typically worked in combination with the well-communicated expectation that everyone participates and maintaining productive group dynamics. Asking group members to help their peers participate has aided in this context.

Group self-evaluation used to be expected during each PBL session early in the evolution of the course. This requirement has been toned down considerably over the years and it still frequently becomes obvious that students have little enthusiasm for self-evaluation, which should not be overdone. In this context it is notable that many groups expect considerable room to develop, and too much guidance can stifle their learning experience. There is a tendency to split up learning issues among students which then somewhat limits the discussion after presentation in class. It is best to split up smaller learning issues, but retain a number of large issues for all students to investigate to provide a basis for a productive discussion.

Discussion

Students learn a wide variety of skills in the PBL format. They must first identify the patient's problems. Then, mechanisms producing the problems are discussed and hypotheses are generated. Students identify what they know and what they don't, resulting in a list of learning issues. After ranking, the important learning issues are researched by everyone for the second session. The group then meets again to discuss what they have learned, teach each other, make correlations, identify inconsistencies, and share sources of information. Then, the mechanisms and hypotheses are refined. At this point, the next part of the case is given out, and the above process is repeated for the third session. After discussion in this final session, the case is reviewed by construction of a concept map.

The concept map helps each group understand the basic science, medical, and socioeconomic correlation behind the case as they relate to hypotheses, mechanisms, and problems. It allows students collectively to connect and integrate all multidisciplinary aspects of the case into a logical diagram that results in a diagnosis. It ensures students identify the most important aspects of the case, as well as identify knowledge gaps and misconceptions. It provides an opportunity to synthesize the big picture and demonstrate that the integration of basic sciences is required to understand cases. In addition, the process of drafting a concept map helps the facilitator and the group to keep track of their progress and engages the students in active participation and discussion.

PBL facilitators have a unique opportunity to get to know seven to eight students well. Groups typically meet for 90 minutes per week over multiple weeks during one term. Group and facilitator compositions are typically scrambled for the second term to enhance the experience for students and they learn to

adapt to new team members with different personalities and a different facilitator. There are no formal examinations. Assessment is focused on the skills involved in the PBL process and on skills related to professionalism. Assessed skills include use of the student's own knowledge base, knowledge acquisition/active learning, critical thinking/reasoning/problem-solving, teamwork/group communication, and assessment. Typically, the main means of PBL performance assessment include group and individual assessments during each session, a midterm one-on-one meeting with the facilitator, a final written narrative evaluation, and a professionalism evaluation tool completed at the end of each term for each student by their facilitator.

PBL has been evolving towards a paperless format and some potential pitfalls lie in the online format in which different components of the case material are electronically released at precise times. This requires a reliable mechanism to ensure that the specific material is available at specific times for session. The discussion in class and development of relevant hypotheses based on reasoning and joint brainstorming is easily disrupted by a quick online search for the correct diagnosis. Since student interest in discussing the case declines after a correct diagnosis has been established, the use of online information should be discouraged.

The online format also typically results in an online document that the students share to list relevant material for the case. If students post their learning issue research online prior to the next session, this will likely limit what students who first read the already-posted material may contribute. Thus, it is beneficial to ask students to avoid posting their research online in advance, and ask they show their research around the table in class so that every student is challenged to contribute. This information can be made into a shared online document at the end of each session. Finally, students should be encouraged to use the white boards whenever possible during sessions. The whiteboard helps to preserve information, capture important points, and synchronize the discussion in class around the topics highlighted on the board.

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